Introduction: Product innovations - on why an how it matters to firms and the economy

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1. Introduction: Product innovation – on why and how it matters for firms and the economy

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1. Introduction

The aim of this book is to contribute to the understanding of product innovation how it takes place how it affects firms and the economy. Our analysis of product innovation links it to interactive learning and to the performance of firms. On the basis of unique data sets and detailed case studies we study the interconnections between these three elements from different angles. We believe that the book will prove helpful for managers, employees and policy makers as well as for all those in academia who wants to understand the role of product innovation in the economy.

Product innovation is a complex and multidimensional phenomenon and in order to capture this complexity we combine different theoretical perspectives, different levels of aggregation, and different methodological approaches. We apply economic, institutional, organizational and sociological perspectives and we combine quantitative studies with qualitative case studies. At the same time there is coherence across the different parts of the book reflecting a focus on product innovation, organizational change and industrial dynamics. The team that has produced the book has a long history of interdisciplinary collaboration. This is obviously the case for the Aalborg scholars but it is also true for the three outstanding external scholars, Lam, Lorenz and Tomlinson, who have contributed to the book. The Aalborg researchers have been involved in long-term collaboration with them in several international research projects.

Important parts of the book are based on empirical material gathered in connection with the specific research project PIE – product innovation and economic performance in Denmark[1]. The project organized the gathering of different types of data sets on technical and organizational change in Danish firms. A major survey on innovation, organization and competence building that covered activities in 2007 responding firms for the period 1998-2000 was one source and to these data were linked register data on economic variables as well as the comprehensive labour market data based IDA. These data sets have been used to analyse what factors that promote product innovation and to analyse how innovation relates to economic performance (see chapters 7, 11 and 14).

A different kind of data set was gathered through detailed consecutive interviews in firms and covering different specific product innovation projects. In each firm there were at least three consecutive interviews and in each firm several individuals involved in the product development process were interviewed. The major aim of this part of the project was to gain concrete and detailed insights regarding the role of knowledge and learning in the context of product innovation (see chapters 4, 6 and 10).

2. Product innovation and the performance of the firm and the whole economy

Both at the level of the firm and at the level of the economy as a whole, product innovation is of major importance. For the economy as a whole, the introduction of new products is fundamental for economic growth. Process innovation without product innovation would sooner or later result in economic

[1] This project was part of a large-scale Danish research project called LOK – Management, Organisation and Competence building. We thank The Social Science Research Council for financial support for this research.

stagnation and in what has been called ‘technological unemployment’. To avoid satiation of demand increasing income levels need to be sustained by the offering of new products and services.

Surveys addressed to firms show that, in high-income countries, the introduction of new products – not only modified ones - are events that take place frequently in most parts of the economy. For instance, over a period of 2-3 years, normally about half of all Danish private firms report at least one product innovation. The reason why firms introduce new products is that they want to attract demand and maintain their position in competition with other firms. In some sectors, such as information technology, frequent introduction of new products is absolutely necessary for the firm’s survival while in other sectors, such as food industry, the rate of change in products may be slower. But also in sectors traditionally seen as low-tech due to their low level of R&D-intensity product innovation may be crucial to attract customers from competitors.

3. But product innovation is absent in standard economics text-books

Product innovations are thus important both for the survival of the single firm and for sustained economic growth. In spite of that, remarkably little is said about product innovation in standard textbooks in economics. Theoretical models of production, the so-called production functions, take into account technical progress when it results in more efficient processes of production but tend to neglect product innovations. One reason for this neglect is methodological and has to do with the predominance of quantitative models in economics (Lundvall, 1987).

There is a general ambition among economists to transform all aspects of reality into quantitative variables that can be manipulated within continuous mathematical models. This is one reason why, in

general, innovation studies are not well developed in standard economics. There is little doubt that technological change, fundamentally, is a *qualitative phenomenon.* Discovery, invention, and innovation can even *be defined as* activities giving rise to new qualities, which did not exist before the act of discovering, inventing, or innovating.

In the real world, growing efficiency in production is, of course, a phenomenon inseparable from changes in product quality and the introduction of new products. New products stimulate aggregate demand and growth and it is the growth of real incomes, induced by growing productivity that stimulates the demand for new products (Pasinetti, 1981). This is reflected in the close statistical correlation between economic growth and structural change. It is impossible to understand the dynamics of industrial development, without taking into account that new products and new product qualities are introduced.

4. The management literature recognizes the importance of product innovation

The management literature gives much more attention to product innovation. It addresses the challenges of product innovation for management. It instructs managers to keep track of the process, to establish gateway meetings, to co-ordinate the efforts of different departments within the firm. As we will show, 'to manage product innovation' is a very demanding task and one of the most efficient ways to do so is to establish a learning organization characterized by continuous horizontal communication. This reflects that product innovation processes mobilize knowledge and competence among many individuals belonging to different spheres of activity and the process is very much one of interaction between people and specifically about 'interactive learning'.

Related to the interaction between learning individuals is the interaction between organizations that results in inter-organizational learning. Long term relationships with other firms, knowledge institutions and consumers stimulate and shape product innovation activities in different ways. Firms that are customers signal new needs that may be addressed by new products. Firms that supply services, materials and equipments signal new technological opportunities that may be integrated in the new product. But it is not only by influencing the agenda for product innovation that external organizations play a role. During the development process there is often an on-going process of inter-organizational communication and co-operation and how well it works will be reflected in the market success of the new product.

5. Interactive learning, markets and hierarchies

Standard economics focuses too much on how markets separate one organization from another and has difficulties in explaining the frequency of long-term collaboration in dynamic sectors characterised by frequent product innovations. Industrial networks appear as anomalies as compared to the individual firm selling its services on an anonymous market. Transaction cost theory gives one explanation on why vertically separated units are brought together in hierarchies, but it has difficulties to explain the intermediate forms where firms remain legally independent but still get committed in long-term relationships. Here we will offer a different explanation of why network relationships and relational contracting are so frequent. We will argue that they are established *because they are the most effective institutional form when it comes to reaping benefits emanating from interactive learning*.

Such an explanation needs to take into account that interactive learning is deeply embedded in social life. The outcome of learning processes will depend on social relationships such as trust, authority and

recognition. Therefore, the broader societal and socio-economic context needs to be taken into account when analysing the formation of network relationships. In this context the restrictive view of standard economics where everything is reduced to individual instrumental or strategic rationality is insufficient. To understand the dynamics of product innovation and the formation of network relationships it is necessary to broaden the perspective and to let insights from other disciplines than economics be integrated in the analysis.

6. Product innovation as a process of communication in an environment of uncertainty

There are two characteristics of product innovation that makes it a process where social and economic elements are intertwined in a complex way. One is the fundamental uncertainty it involves. Uncertainty in connection with innovation is *fundamental* in the extreme sense that the very aim of the process is to come up with something unknown. While normally we define uncertainty as a situation where *the unknown may happen* innovation is a process where *we know that the unknown will happen*. We might define this as *radical fundamental uncertainty.* This is why it is a process where beliefs, intuition and creativity are as important, or more important, than calculation and optimisation.[2]

The second important characteristic is that it is a process where the outcome is highly dependent upon *interaction and communication* between people. Individual actors may try to realise their own

[2] We do recognize that the kind of innovations studied in the Danish surveys and case studies reported in this volume are incremental and sometimes have elements of imitation. Even in these cases surprises are bound to happen both on the side of technologies and the side of markets. Taking into account the capability of the agents to cope with change the uncertainty might be quite high also in such instances.

intentions but they have to do so in a context where the resources they need to mobilize are shared with others and actually change in the very process of interaction. This is one reason why 'methodological individualism' cannot be applied to processes where knowledge and learning are central (Arrow, 1994).

This combination of uncertainty and interaction makes product innovation a social phenomenon in two respects. First, social relationships are fundamental for commercial outcomes; the social institutions shape economic development. Second, the innovation process affects social relationships within firms and between individuals belonging to different organizations. Some of the learning that takes place is 'relational learning' and this kind of learning affects how people and organizations relate to each other.

According to George Herbert Mead, the extension of markets has a civilising effect since the market is an institution where sellers have to take buyers seriously and regard them as 'significant others'. It is interesting to note that product innovation, much more than standard market operations, may be seen as a process where close interaction and understanding is required. The innovating producer needs to get an idea of user needs not served by existing products. This implies that in an economy where product innovation is a frequent phenomenon we would expect more closely knit social networks than in a static market economy where the focus is upon the exchange of commodities with given use value characteristics.

This implies that product innovation will flourish in contexts where there is a multitude of 'strong and weak ties' among users and producers. Trust, common language, common routines are necessary prerequisites for a complex interaction with uncertain outcome. This is why short 'social' or 'cultural' distance may be a prerequisite for innovation. Sometimes there is also a need for short geographical

distance making it possible for the interacting parties to meet face to face. These are some of the arguments behind the proposition that it is meaningful to analyse regional and national systems of innovation.

7. The innovation prone economy is a mixed economy

It follows that a market economy where product innovation is an important integrated process must be a ‘mixed market economy’ rather than a ‘pure market economy’. Markets are mixed – combining elements of markets with elements of trust, power and communication channels – and hierarchies are also mixed – combining elements of authority with elements of loyalty and commitment.

How people relate to each other and what categories of people that most easily relate to each other are crucial elements in what constitute the specificities of a society. In countries where the elite is trained in separate schools – France and England may be used as examples – we would expect a different pattern of communication and therefore a different mode of innovation than the one that we would find in Nordic countries with highly egalitarian education systems. If there is a strong tradition among experts to stick to what you know best and be sceptical to what other professions can offer (again France might be a case) that would give a different pattern of communication and a different mode of innovation than in a society where there are more fluid borders between professions.

It is evident from the above that human resources play a pivotal role in product innovation. Product innovation is based upon competences and it involves processes of interactive learning within as well as across organizational borders. Hitherto the literature on technological progress and innovation systems has tended to give too little attention to this aspect and given much more attention to research

and development. However, in recent years the literature has caught up on this aspect. Innovation systems are increasingly seen as building upon the competencies embedded in people and organizations, and innovation studies increasingly give some attention to the education system and the labour market (Lundvall and Christensen, 2003). This book has the aim to move the analysis further ahead in this respect.

8. Social capital and small countries

The sharing of a common language and the willingness to co-operate with parties with different interests are more or less easy to establish in different countries reflecting not only the education system but also how societies are stratified. To overcome uncertainty, to build trust and to establish a common language takes time and it may be seen in the light of accumulation and destruction of 'social capital'.

Small countries have developed dense social networks both at the national level and at the level of the single firm making adaptation more rapid and less costly. Nation wide networks, including representatives of workers and employers as well as policy makers, permit swift institutional reforms when external circumstances make it necessary. Combined with a reasonably high, rather evenly and widely diffused level of education these characteristics make it possible to be rapid in establishing new competences as these are required (Maskell et al., 1998). These 'small country-advantages' may give an explanation of why many small countries, in spite of increasing returns to scale in knowledge production and use, are listed among the most competitive in the world in an era where knowledge is a key production factor.

The Danish economy may be of special interest as an illustration of this small country advantage since its formal knowledge base appears to be rather weak. Denmark is among the richest countries in the world. But Danish firms, with the exception of a few pharmaceutical firms, pursue relatively little R&D. Denmark is extreme among the small countries in actually increasing its specialisation in low technology products in the nineties. At the university level Denmark invests less money per student level than other OECD-countries when the income level is taken into account. On the other hand, Denmark is also extreme in the sense of social capital based on egalitarianism and small power distance. It is the country in the world with the most equal income distribution and with the highest rates of unionisation (Lundvall, 2002). These properties are important for understanding the context of the product innovations and interactive learning studied in most of this volume.

9. The structure of the book

Our analysis of product innovation links it to interactive learning and economic performance. We tackle the interconnections between these elements from different angles. The first part is about how knowledge and learning relate to innovation – it introduces conceptual issues and alternative theoretical perspectives and models. The second part is about interactive learning in connection with product innovation. The third part considers how human resource management and industrial relations affect product innovation and learning. The fourth part explains how the organizational and inter-organizational context affects and shapes innovation processes. We pursue this aim by focusing upon the interaction between innovating firms and knowledge institutions. Finally, whereas we in several chapters discuss different kinds of performance in connection with product innovation we end up by relating product innovation to economic performance in a strict economic sense.

Perspectives on learning

Chapter 2 by Lundvall gives an overview of how knowledge is treated in economic theory and makes an attempt to develop new concepts that makes the analysis of knowledge and learning more adequate and useful. It ends up by sketching the contours of a new type of economy – the learning economy - where the capacity to learn is crucial for the success of individual actors, organizations and regions. One central element in this chapter is the analysis of how learning and innovation are interrelated and it is argued that it is not possible to understand innovation processes without going deeper into the understanding of learning and knowledge.

In chapter 3 Alice Lam pursues this line of thought in an institutional context. She demonstrates that there are important connections between the formation of competences at the level of the individual, the structure of the labour market and the organizational framework within which learning and innovation takes place. A training system that fosters en elite isolated from workers will innovate differently than one where education is more broad-based. A labour market organized around professions will promote different kinds of learning than one where internal labour market in the firm is dominating. Lam uses national models (the US, UK, Japan and Denmark) to illustrate her analysis. The chapter is an important contribution to a broader understanding of national innovation systems that gives adequate weight to the competence building as connected to education, labour markets and learning inside firms.

Chapter 4 by Reinhard Lund is one of three chapters in the book that draw upon a series of longitudinal case studies of specific product innovations in small and medium-sized Danish firms. In this chapter

the focus is upon the use of knowledge in connection with the product innovation and upon the attempts to establish 'knowledge management' to promote learning in connection with the innovations. Here the connection between innovation and learning as referred to in chapter 2 are spelled out in a very concrete way. A point of departure is the analytical framework developed by Hargadon and Fanelli (2002) arguing that also seen from a management point it is extremely useful to keep tract both of innovation and learning and to understand the linkages between the two. One interesting result in this chapter is that while only one of the five firms included in the study had an explicit knowledge management strategy all firms had elements of such a strategy that remained implicit. Normally people in the firms were not prepared to express themselves in terms of 'knowledge' and 'learning' but when probing it became clear that they have developed practices that aim at promoting the use of knowledge and learning.

Product innovation and interactive learning

Chapter 5 by Lundvall and Vinding on product innovation and economic theory introduces the next section about product innovation and interactive learning. The chapter demonstrates that while product innovation is of major importance both for economic growth and for the competitiveness of firms it has been largely neglected in standard economic theory. It goes on to show that the real-world frequency and scale of product innovation cannot be explained neither by standard economics nor by transaction economics. It is shown that combining product innovation and interactive learning in the analysis of industrial organization leads to radically different conclusions than what would follow from an analysis based upon transaction economics. An important suggestion with major theoretical and practical implications is that 'interactive learning' is a major element in promoting economic growth since it is

one of the most important mechanisms that transform local knowledge into more generally accessible knowledge.

Chapter 6 is by Reinhard Lund and here the case studies referred to in chapter 3 are used to identify and analyse *learning situations* in connection with the specific product innovation processes followed in the firms. The chapter illustrates at a concrete and detailed level the importance of interactive learning alluded to in chapter 5 both within and across the organizational boarders of the firms. The interactive learning across divisions and with external parties was seen as becoming more important in all the firms. These changes were driven by the general understanding that earlier innovation strategies had been too dominated by technological concerns and engineering motivations and too little by market concerns and the over all business goals. The chapter reveals important trade-offs in connection with learning in the context of product innovation. One of the most important may be seen in the light of the speed-up that characterises the learning economy. The increased focus by top management on 'speed to market' is reflected in developers feeling more restrained in their creativity and there is also a tendency that developers, production technicians and market people experience that there are too many unsolved problems with the first generation of the product. Interviews also imply that there is too little time for reflection and 'secondary loop' learning.

Chapter 7 by Anker Lund Vinding analyses interactive learning within and across organizations on the basis of survey and register data using econometric techniques. The theoretical focus is on the absorptive capacity of firms giving equal weight to the internal competence (know-how and know-why) and the network relationships (know-why and seen as 'social capital'). The analysis gives highly significant results that support what has been concluded in earlier chapters on the strong

interconnection of innovation and learning – on the one hand the firms that have introduced 'learning organizations' with dense internal interaction are much more innovation prone than the rest. On the other hand firms that establish 'complete networks' -closer relationships vertically with users and suppliers as well as to knowledge institutions are much more likely to innovative than the average firm. An interesting result is that there is no positive correlation between the length of work experience of managers and innovation. This may be seen as an indication of the learning economy where competences tend to become obsolete at a high rate.

Industrial relations, HRM and the organization of product innovation

Chapter 8 by Edward Lorenz, Jonathan Michie and Frank Wilkinson compares two different innovation systems - the UK and France. The focus is on how far the use of high performance work practices can explain product innovation in the two countries. It is a pioneering study since earlier international comparative work, with few exceptions, have used other performance indicators than innovation. The method is first to pursue a factor analysis trying to locate clusters of firms that combine similar sets of practices and then to use these clusters as explanatory variables in relation to product innovation. A general result, in accordance with what was found in chapter 7, is that the use of HRM-principles and instruments increases the innovative potential in the firms. It is also shown that there are complementarities between instruments that might make it difficult to get them implemented in an incremental fashion. An interesting result is that there are quite substantial and somewhat counter-intuitive differences that reflect institutional differences in the labour market between the patterns in respectively the UK and France. Firms in France have certain obligatory forms of representation of

employees and that results in that the connection between such representation and innovation does appear as significant in France while it is insignificant in the UK.

Chapter 9 by Mark Tomlinson gives a useful complementary view of competence building in the UK labour market. He uses the Employment in Britain data set which has gathered information from almost 4000 employees and self-employed. The focus is upon how far the employee felt strongly that he or she was learning new things in connection with the job. This variable is related to age, race and gender. It is also related to work practices that are connected to the Japanese model of learning organizations and to the inter- and intra-firm mobility between jobs. Again it is found that employees working in firms using HRM-practises learn more than the average. Also for the individual the performance of learning organizations is to prefer. One very interesting result that calls for international comparisons is the observation that while job shifts within firms promote individual learning this is not true for job shifts between firms. Finally, the observation that women learn less than men after all other factors such as sector and job position has been taken into account points to a kind of dynamic job discrimination that is more serious than the one reflected in low pay. Again it would be most interesting to see if this reflects a nation specific pattern – the author mentions that he did not find any such pattern when studying countries in Eastern Europe.

Chapter 10 by Reinhard Lund is focused on innovation management and takes its empirical observations from eight specific product innovations in four medium-sized firms. It is interesting to note that in all the studied firms there seems to have developed a stronger consciousness among management about the importance of certain types of interaction in connection with innovation. This has been combined with a more systematic use of central management techniques such as regular

stage-gate meetings and involvement of users as well as shop floor workers early on in the process. One interesting result is that there is always a dilemma when it comes to formalize and standardise procedures. On the one hand such standardisation may work as a checklist making certain that all necessary co-ordination actually takes place. On the other hand it may develop into routines that hamper the interest and creativity of participants. The chapter demonstrates that firms tend to adjust their procedures in these and other respects as new experiences are made. Innovation management involves learning by doing.

Interaction with knowledge institutions and product innovation

Chapter 11 by Anker Lund Vinding is focused on the interaction between firms and knowledge institutions in the context of product innovation. The chapter introduces a simple model combining the concept of 'absorptive capacity' with the concept 'strong ties' using the occurrence of academic employees and the strengthening of interaction with knowledge institutions as indicators. The econometric analysis demonstrates that the probability that firms introduce product innovations is the highest among those firms that combine strong absorptive capacity with strong ties. An important result is that the strongest correlation is found for small firms and firms that are not belonging to the science-based sectors. This indicates an opportunity for stimulating innovation by giving this kind of firm incentives to hire academic employees and to strengthen their collaboration with knowledge institutions. This is one reason why a one-sided focus on high technology and high technology sectors in innovation policy is detrimental to innovation.

Chapter 12 by Ina Drejer and Birte Holst Jørgensen differs in focus from most of the other chapters in studying the formation of new firms in connection with quite radical product innovations. This is an

important complement to the focus on existing firms in other chapters. The chapter analyses two different cases – both within the broad field of sensor technology – and especially how the interaction between private and public actors evolve in different stages of the innovation process – using an extended version of the Rosenberg - Kline Chain link-model as organizing the presentation. One of the innovations (electronic pen) is defined and demand driven and the other one as technology driven (silicon microphone). The cases illustrate that public-private collaboration can be established and that collaboration supports interactive learning with benefits both for the firm and the public knowledge institutions. But it also demonstrates that there are some extra costs in building relationships from scratch as compared to already existing networks. Neither complete detailed and rigid contracts nor purely informal networking can stand alone and striking the right balance will typically require some 'relational learning' among the parties involved. Especially in fields where there are high barriers to overcome before partners can join and where collaboration is crucial for exploitation of new technological opportunities public incentives have a role to play.

Chapter 13 by Jesper Lindgaard Christensen gives different complementary perspective on innovation and interactive learning. The focus is on the role of the national patenting office in Denmark - its internal learning and how it learns in interaction with Danish client firms. The chapter raises two policy relevant questions in this context. Does the organization of the patenting office promote learning internally and externally? Is there a rational for keeping a specific Danish patenting office or could the same functions be fulfilled by the EPO in Munich? The answer to the first question is ambivalent. The character of the knowledge flowing between departments within the Patenting Office may explain an internal organizational structure where the marketing department operates only with limited interaction with the main 'production department' where patent applications are processed. A more interactive

form was tried out but showed inexpedient even if it to some extent would promote and speed up learning internally. The result is in this sense an important complement to several other chapters pointing to the benefits of learning organizations: the practical implementation of such an organizational structure is limited by the specificties of the organization and the character of the knowledge exchanged. The answer to the second question is also mixed. It is concluded that the Office takes on certain indirect services of importance for the national system of innovation – such as upgrading expertise among their employees in handling patents and then exporting them to private firms. Also, the Office is disseminating information on IPR, and has become the most central node in a national network of experts and practitioners on intellectual property rights. Regarding its primary function – to grant patents and trademarks – it seems as if the Office has a role as an entrance to the IPR-system for very small and weak players who cannot afford the services of a private agent and for very strong players who know how to get the best out of the patenting office. For firms between these extremes it is possible to use private patent agents and could as well operate in direct interaction with the EPO.

Product innovation and economic performance

Chapter 14 by Toke Reichstein analyses the relationships between the growth of firms and product innovation. He makes use of two data sets that are quite similar and include a combination of survey data and register data. The first data set covers 1003 firms 1994-5 and the second covers 1678 firms 1998-99. The chapter presents an econometric analysis where innovation is the dependent variable and growth in respectively employment and revenue are introduced together with a multitude of explanatory variables that have been shown to affect product innovation in chapters 7 and 11. This procedure is chosen in order to avoid spurious correlation. The analysis ends up demonstrating that

there is a significant correlation between product innovation and growth in employment in both the periods studied. The correlation between product innovation and revenue growth is significant for the first set of data but not for the second. An interesting observation made is that firms that engage in product innovation tend to be more reluctant to reduce the work force in situations with stagnating demand. The first period studied was part of a long period of stable economic growth while the other is one where growth stagnates.

10. Challenges ahead

In this volume we have brought together different elements of a more complete understanding of product innovation and linked it to interactive learning and economic performance. Such a broader understanding raises new challenges for management, public policy and research. We conclude this introduction with some brief reflections on these challenges.

Challenges for management

Within firms, learning for product innovation generally requires an interaction between the specialized divisions and functions in charge of respectively, sales, production and R&D. Sales departments will feed the firm's development process with information about user needs while the production department will contribute with practical information about what production costs for alternative designs of the new product. Development departments will keep track of and inform about new technological opportunities.

This is one reason why product innovation is very demanding for management in terms of organizing co-ordination and learning. It involves individuals from all parts of the organization in an interaction

and co-operation over a period and at the same time it involves interaction and collaboration with external parties. Within the firm there is a need for individuals who work in different departments and functions and often belong to different ‘communities of practice’ to understand each other and to communicate in a context of radical fundamental uncertainty.

In such situations it is problematic exclusively to trust incentive mechanisms related to pay or threat of job loss. And actually it might not be necessary. A context where a broader circle of employees get engaged in common search for solutions in the context of uncertainty may be felt to be ‘interesting’ for those taking part. The most advanced managers are those who focus more on enhancing ‘the pleasure of learning’ as incentive than he does on enhancing material incentives.

To manage innovation is also to manage conflicts in the organization. There is a need to establish some degree of trust between communities with different interests. The sales department and the production department will typically make attempts to impose their needs on the development department that also has its own agenda. Even so the collaboration between these different parties is often a prerequisite for the success of the product innovation.

A key problem is to establish communication vertically as well as horizontally. Here the language used in the communication is important. It can be formalized and codified giving a strong position to academically trained professionals or it can be informal and intuitive giving a strong position to ‘insiders’ who have learnt the language in practice. And there might be parallel discourses that from time to time may get in dissonance with each other. To be aware of what languages that are used and to install ‘translation’ at crucial steps in the innovation process is of key importance.

In the current context perhaps the most difficult daily challenge for management is *patience* in relation to the width and timing of innovation activities. To what degree can product innovations be narrowed down to operational adaptations to immediate market demands without undermining the long-term building of new capabilities? To what degree can the different stages of the innovation process be accelerated without losing control with the quality of the outcome, including the room for learning among the employees involved? A thorough innovation process that ends up with no need at all for debugging the innovation is normally not rational but on the other hand there are many examples of premature launching of innovations.

Challenges for policy makers

There are several more specific remarks in the chapters of this book on policy implications. What will be said here is brief and general. First, it is obvious from our analysis and many others that product innovation promotes economic growth and that product innovation promotes job creation in the economy as a whole. This implies that policy makers should reflect upon how they best can stimulate product innovation.

There are several generally accepted lines of action that find support in our analysis. Education and training is crucial. Basic research is important as well. Access to venture capital is important especially for stimulating radical innovations and start up firms. These are uncontroversial instruments but even those are not always used fully because there is an unwillingness to allocate the necessary resources.

We would like to add some remarks on instruments that are popular but that might not be very efficient seen in this dynamic perspective. The general assumption that it is always a good idea to make life as easy for private firms as possible is basically unsound. Low wages, low taxes, trade protectionism, undervalued currencies and a slack regulatory policies do not stimulate innovation. Rather they increase slack in existing firms and they guarantee the survival of firms with limited life expectancy. Neither is it clear why 'entrepreneurship' in the elementary form of a high frequency of new firms would promote innovation. Most start-ups are based on old trivial technologies and their life expectancy is low. It is true that in some sectors technology based start up firms may be necessary to exploit new technological opportunities but this is a different issue than the general promotion of as many new small businesses as possible.

Third there are instruments that need to be taken seriously into account but appear to be controversial. These are instruments that can be seen as legitimate only if we assume that firms do not by themselves find the best way of doing things. This might be because they follow old routines and trajectories reflecting that they operate in a context of (radical) fundamental uncertainty or because they operate on the basis of compromises among different interests that make change difficult.

The reader of this book will find at least two types of examples where policy could make a positive difference. One is related to the hiring policy of small traditional firms and to the fact that such firms are reluctant to the hiring of employees with academic degrees. There is quite strong evidence that a change in behavior in this respect would have a major impact on the innovation activities in the firms as well as in the economy as a whole. The other refers to organizational forms. There is strong evidence indicating that a diffusion of good practice regarding networking, HRM, Industrial Relations and

organizational flexibility would have a major impact first on innovation and second on economic growth in the whole economy.

One way to promote the diffusion of good practices is to make sure that the transformation pressure (competition) is strong. We have seen how firms that are exposed to intensified competition tend to be more active in introducing good practices. But from the point of the view of the whole economy this mechanism might be seen as working to slowly and as being too costly as compared to other more direct forms of intervention. Bringing together managers, employees, scholars and policy makers in for aiming at finding the best ways to stimulate organizational up-grading could be a first step toward developing creative public-private programs aiming at promoting the diffusion of good organizational practice.[3]

Challenges for theory and research

One implication of the important role of social dimensions is that it is difficult to develop a *general theory* of innovation and interactive learning. The processes involved are highly context dependent and the best we can do is to develop models that bring to the fore differences in context as *different*

[3] It might be worth noting that the two examples illustrate a counterintuitive pattern found in our analyses of product innovation in Danish firms. We find that the small low tech firms are the ones that have most to gain from strengthening their connection to academic knowledge while we find that organizational change bringing firms closer to the ideal of learning organisations have most benefits to offer for high technology and science based firms. The results are not incompatible with standard economics since we might put this in terms of decreasing returns. The explanation can be that high technology firms have already satiated their needs for access to academic knowledge while they often have problems with speeding up the learning in all activities outside research and development. In the small traditional firms the gains from speeding up organizational learning may be limited as long as they are weak in coping with formal and codified knowledge.

patterns. We need to ground theory in case studies and comparative work and only on this basis is it possible to approach more general insights.

In order to understand how technical and organizational change affect economic growth it is necessary to establish a link between the macro-, meso- and the micro level of analysis. For instance our analysis demonstrates that more intensive competition – something that might emanate from macroeconomic change – has an impact both on efforts to innovate and on innovation outcomes. On the other hand, we can show that the job creation that results in employment growth at the macro level reflects a multitude of specific innovations and learning experiences at the level of the single firm and at the level of the single individual. A major challenge is to develop a theoretical understanding of how the transformation pressure experienced by firms is an aggregate outcome of actions and learning within and between those same firms (Lundvall and Nielsen, 1999).

In order to respond to this challenge we need to go even further into what role different types of knowledge and different forms of learning play in connection with product development. Such an approach is reflected in the present book. Some of the chapters deal with the innovation system as a whole, others look for sector specific patterns and still others analyze what is going on inside firms. But all of them try to be explicit in their attempts to understand the role of learning and knowledge in relation to innovation.

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